UNIVERSITI PUTRA MALAYSIA

MICROPROPAGATION OF MANGOSTEEN (*GARCINIA MANGOSTANA* L.) BY DIRECT AND INDIRECT ORGANOGENESIS

SUCI RAHAYU

FP 2007 3

MICROPROPAGATION OF MANGOSTEEN (*GARCINIA MANGOSTANA* L.) BY DIRECT AND INDIRECT ORGANOGENESIS

SUCI RAHAYU

MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA

2007

MICROPROPAGATION OF MANGOSTEEN (*GARCINIA MANGOSTANA* L.) BY DIRECT AND INDIRECT ORGANOGENESIS

By

SUCI RAHAYU

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

April 2007

DEDICATION

I dedicate this thesis to my father, Gito Soewarno and my mother, Subariah.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

MICROPOPAGATION OF MANGOSTEEN (*Garcinia mangostana* L.) BY DIRECT AND INDIRECT ORGANOGENESIS

By

SUCI RAHAYU

April 2007

Chairman : Associate Professor Mihdzar Abdul Kadir, PhD

Faculty : Agriculture

The mangosteen *(Garcinia mangostana* L.*)* still remains an under exploited tropical fruit species that has potential to be developed for local consumption and export commodity. The problem for large scale planting of this plant is not having enough planting materials because the conventional vegetative propagation method has low percentage of success. One of the alternative approaches for mass propagation of mangosteen is through tissue culture. The advantages of propagation through tissue culture are mass propagation can be achieved in a short of time period, plantlet can be produced all year round, and require less space of the plant in the laboratory compare with to the field. The result of the study on *in vitro* propagation of mangosteen in terms of production of adventitious shoots through direct organogenesis and indirect organogenesis in term of callus induction was conducted at the laboratory of Faculty of

Agriculture, Universiti Putra Malaysia. It was observed that among 24 initiation media tested, 16 mg/l BAP gave the highest number of shoots (7.00 shoot/explant), followed by 8 mg/l BAP (6.3 shoots/explant) after eighth weeks of culture. In general, the supplement of AdS in media did not significantly influence the number of shoots produced.

There was negative correlation between the height of shoot and the number of shoot produced. The highest number of shoots was recorded on media with 1 mg/l and 2 mg/l BAP, while the shortest shoot was on media of 16 mg/l and 8 mg/l BAP. Contrary to the height of shoot, there was positive correlation between the weight of shoots and the number of shoots. Treatment with 16 mg/l and 8 mg/l BAP gave the highest weight of shoots produced per seed explant.

During subculture, treatment with BAP 2 mg/l gave the highest number of shoots at every occasion of subculture (39.56 shoots per explant), followed by 1 mg/l BAP (27.71 shoots per explant). Height of shoots on all media of subculture did not significantly differ. Combination of 1 mg/l BAP and 2 mg/l Kinetin was the most suitable media for elongation of the shoot (1.06 cm).

Among the rooting media, ½ MS + 15 mg/l NAA + 0.05% Charcoal + 10 g/l sucrose was most suitable for the emergence of roots with 3.4 roots per shoot). While ½ MS + 1 mg/l IAA + 0.05% Charcoal + 10 mg/l sucrose seemed to be most suitable media for lengthening the roots. The average length of root on this

media was 6.85 cm per shoot. Plantlets from rooting experiments acclimatized on the media of soil + sand + peat (2 : 1: 1) have grown well. 100% of them could survive under misting chamber condition for eight weeks.

In study on organogenesis through callus induction, all media with the exception of MS, BAP alone and 2,4-D alone could produce calli.

It is expected that this findings can contribute to the knowledge of science, particularly on *in vitro* propagation of mangosteen, and can be used as a reference for other students and researchers as well as agricultural industries in developing mass propagation of mangosteen.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PEMBIAKAN MIKRO MANGGIS (*Garcinia mangostana* L.) MELALUI ORGANOGENESIS SECARA LANGSUNG DAN TAK LANGSUNG

Oleh

SUCI RAHAYU

April 2007

Pengerusi : Profesor Madya Mihdzar Abdul Kadir, PhD

Fakulti : Pertanian

Manggis (*Garcinia mangostana*) merupakan antara spesies buah tropika yang belum diterokai, meskipun ianya mempunyai potensi untuk dikembangkan sama ada untuk pemakanan tempatan mahupun untuk komoditi eksport. Permasalahan yang berlaku adalah tidak cukupnya anak pokok untuk penanaman skala besar. Pembiakan vegetatif secara biasa mempunyai peratus kejayaan yang rendah. Salah satu pilihan untuk pembiakan secara besar-besaran ialah dengan kultur tisu. Keuntungan pengembang biakan dengan kultur tisu adalah pembiakan secara besar-besaran dapat diperolehi dalam waktu yang lebih pendek, produksi anak pokok dapat diperolehi sepanjang tahun dan jimat ruang penyimpanan dalam makmal berbanding penyimpanan anak pokok di lapang. Hasil kajian dari penyelidikan kultur tisu dengan tajuk Pembiakan Tampang Manggis Melalui Organogenesis Secara Langsung dan Tidak langsung (Induksi Kalus) adalah

sebagai berikut: Diantara 24 media inisasi yang dikaji, 16 mg/l BAP memberikan jumlah tunas yang paling banyak, iaitu 7.00 tunas tiap eksplan, diikuti oleh 8 mg/l BAP yang menghasilkan 6.3 tunas selepas lapan minggu penanaman di media. Secara amnya, pencampuran AdS ke dalam media tidak mempunyai kesan yang nyata terhadap jumlah tunas yang dihasilkan.

Terdapat hubung kait secara negatif antara tinggi tunas dan jumlah tunas yang dihasilkan. Tunas paling tinggi diperolehi pada media 1 mg/l and 2 mg/l BAP, sementara tunas paling pendek pada media 16 mg/l and 8 mg/l BAP. Kebalikan dari tinggi tunas, terdapat hubungan yang positif antara berat tunas dan jumlah tunas, dengan demikian media 16 mg/l and 8 mg/l BAP memberikan berat tunas yang tertinggi.

Selama subkultur, 2 mg/l BAP selalunya memberikan jumlah tunas yang paling banyak pada setiap subkultur (39.56 tunas per eksplan), diikuti oleh 1 mg/l BAP (27.71 tunas per eksplan). Secara am, tinggi tunas pada semua media subkultur tidak ada perbezaan yang bererti. Gabungan antara 1 mg/l BAP dan 2 mg/l Kinetin adalah merupakan media yang paling pantas untuk pemanjangan tunas (1.06 cm).

Media ½ MS + 15 mg/l NAA + 0.05% ‘Charcoal’ + 10 g/l ‘sucrose’ merupakan antara media yang paling sesuai untuk pemunculan akar, di mana jumlah akar yang tumbuh pada media ini mencapai 3.4 per tunas. Sedangkan media ½ MS +

1 mg/l IAA + 0.05% ‘Charcoal’ + 10 g/l ‘sucrose’ didapati paling sesuai untuk pemanjangan akar. Purata panjang akar pada media ini adalah 6.85 cm per tunas. Eksplan-eksplan dari pada kajian perakaran yang diaklimatisasi pada media tanah dicampur pasir dan gambut dengan nisbah 2 : 1: 1 dapat tumbuh dengan baik. 100% plantlet hidup pada kebuk kalbus (misting chamber) selama 8 minggu.

Dalam kajian organogenesis melalui induksi kalus, semua media kecuali MS, BAP sahaja dan 2,4-D sahaja dapat menghasilkan kalus.

Diharapkan, hasil daripada kajian ini dapat mempertingkatkan ilmu pengetahuan sains, khasnya pembiakan dengan kultur tisu, dan dapat diguna pakai sebagai rujukan sama ada oleh pelajar, penyelidik, mahupun pihak industri pertanian dalam penghasilan manggis secara besar-besaran.

ACKNOWLEDGEMENTS

First, and most importantly, I am obligated to express gratitude to Allah, Most Merciful, for the blessing me granted onto me to execute and complete the study. I am very indebted to those who have helped me in preparing and conducting the study. I wish to express my deepest gratitude.

I would like to thank the Chairman of the Supervisory Committee, Associate Professor Mihdzar Abdul Kadir, PhD for his guidance and advice in the preparation of project proposal, implementation of research, presentation of seminars and completion of the thesis. I appreciate his patience and sincere approach to motivate, help, advise and guide me to finish my study at the Universiti Putra Malaysia. Thanks also are extended to my Committee members, Associate Professor Maheran Abdul Aziz, PhD in particular for her advice, comments, guidance, critical discussion and encouragement in the completion of this thesis and to Mr. Azmi Abdul Rashid who supported me by his encouragement and by the stimulating discussions held with me. They have given me the experience and knowledge, resulting in significant and positive impact on my work.

I am also deeply grateful to the Head of the Agency for Agricultural Research and Development, Department of Agriculture, Indonesia for awarding the scholarship that enables me to pursue a Master program at Universiti Putra

Malaysia, and to the Director of the Indonesia Centre Agricultural Agency for Biotechnology and Genetic Resources Development, Bogor, Indonesia for granting the study leave.

My appreciation goes to all staff of the Tissue Culture Laboratory, Department of Agriculture Technology, Universiti Putra Malaysia: Encik Rozaidi, Encik Ahmad Nazri, Cik Rostina Rolon, Cik Suharni, and Cik Ramisah for their help and assistance while conducting the study. I also wish to extend my gratefulness to Encik Rustam for his kind help to get the fresh-mangosteen fruits as study materials at the Agriculture Training Center in Kalumpang, Selangor - Darul Ehsan, Malaysia. I am indebted to Encik Zainuri, head the Department of Agriculture in Serdang, Selangor-Malaysia.for his help to get information on mangosteen in Malaysia. I am also indebted to Encik Mohammad Yusof Hashim, head of Fruits Division, Department of Agriculture in Kuala Lumpur, Malaysia.for the interest and kindness extended to me by asking Encik Anwar and Encik Amir Hamzah, staff of the Agricultural Department in Rembau, Negeri Sembilan - Darul Khusus and Agriculture Training Center in Kalumpang, Selangor - Darul Ehsan, Malaysia respectively, to provide me with fresh-mangosteen fruits as study material from their orchards. Without their assistance I would have difficulties conducting the experiments.

My special thanks are addressed to my housemates, Rozliza Ismail, Wan Rozidayani Wan Mohammad, Uswati Mohammad Ghazali, Norhazlina Nodin and Siti Khairani Khalid for sharing the joy and sorrow during my stay in Malaysia.

A special note of thanks also to Ibu Dr. Ir. Ika Mariska for her valuable encouragement and attention. Last but not least, I would like to express my deepest thanks to my father, Gito Soewarno and mother, Subariah for their support, encouragement and endless prayers. To my brothers, Teguh Setiono and Kukuh Setiyadi and my Sister, Sari Hening Andajani, thanks for your prayers and moral support. May God bless us all.

I certify that an Examination Committee has met on 25 April 2007 to conduct the final examination of Suci Rahayu on her Master of Science entitled "Micropropagation of Mangosteen (*Garcinia mangostana* L.) by Direct and Indirect Organogenesis" in accordance with Universiti Putra Malaysia (Higher Degree) Act 1980 and Universiti Putra Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

Associate Professor Halimi Mohd Saud, PhD
Faculty of Agriculture
Universiti Putra Malaysia
(Chairperson)

Associate Professor Saleh Kadzimin, PhD
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Associate Professor Datin Siti Nor Akmar Abdullah, PhD
Faculty of Agriculture
Universiti Putra Malaysia
(Internal Examiner)

Ahmad Tarmidzi Hashim, PhD
Malaysian Oil Palm Board
(External Examiner)

HASANAH MOHD. GHAZALI, PhD
Professor/Deputy Dean
School of Graduate Studies
University Putra Malaysia

Date: 3 AUGUST 2007

This thesis submitted to Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee are as follows:

Mihdzar Abdul Kadir, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Chairman)

Maheran Abdul Aziz, PhD
Associate Professor
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

Azmi Abdul Rashid, M.Phil
Lecturer
Faculty of Agriculture
Universiti Putra Malaysia
(Member)

AINI IDERIS, Ph.D
Professor/Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 9 AUGUST 2007

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

_____

SUCI RAHAYU

Date: 25 JUNE 2007

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDICES